ABSTRACT

Index No: 35/16/Phys./24

TITLE OF THE THESIS: Study on Structural, Optical and Dielectric Properties of few Double ($AB'B''O_3$) and Triple ($AB'B''B'''O_3$) Perovskites

SUBMITTED BY: ARPITA BARUA

The present thesis deals with the synthesis and study of the structural, microstructural, optical and dielectric properties of some double and triple perovskite oxides along with a nanocomposite of perovskite oxide, with the goal to understand the impacts of structural and microstructural properties on their dielectric behaviour. The thesis deals with the study of the following materials:

1. The double perovskite Ba_2YbTaO_6 synthesized by solid state ceramic method have been reported along with its structural, microstructural and optical study. The FTIR spectra of the sample has been reported. The dielectric property of the sample has been investigated in dielectric permittivity, dielectric loss, ac conductivity and impedance formalism in the framework of the modified Cole-Cole model. It has been shown that the lattice vibrations associated with its crystal structure strongly affect its dielectric permittivity values.

2. We have reported the synthesis procedure of the perovskites: Ba_2YbSbO_6 (BYSB) and Ba_2YbSbO_6-$BaCO_3$ (BYSN). We have examined how the structural, microstructural and surface adsorbed CO_2 influences the dielectric and electrical transport properties of BYSB and BYSN. The dielectric permittivity and loss tangent values of both the sample has been investigated and we have reported that BYSN exhibits anomalous dielectric and electrical properties above 393 K as it releases the surface adsorbed CO_2 above this temperature. Their electrical conductivity study has been reported. We have shown that the structural and microstructural properties along with the surface adsorbed CO_2 plays a key role in determining the dielectric relaxation and electrical transport properties of BYSB and BYSN.

Arpita Barua
24/03/23

Sanjay Kumar
24.03.2023

Dr. SANJAY KUMAR
Professor
Department of Physics
Jadavpur University
Kolkata - 700032, India

3. We have synthesized Sr_2YbNbO_6 (SYN) and Sr_2YbSbO_6 (SYS) by ceramic method and investigated their structural, microstructural and dielectric properties. The dielectric permittivity, loss tangent and conductivity values of the samples have been reported. We have obtained the permittivity value of SYS to be lower than that of SYN due to the smaller ionic size of Sb as compared to Nb and concluded that the dielectric properties of a sample are largely controlled by its crystal structure and the radii of its constituent ions.

4. We reported the synthesis procedure of $Ba_3NiTaNbO_9$ (BNTN) and $Ba_3NiTaSbO_9$ (BNTS). We have investigated their structural, microstructural and dielectric properties. The partial ordering of both BNTN and BNTS have been investigated with the help of Raman spectroscopy and we have shown that the ordering of $A_3(B'B''B''')O_9$ type perovskites is greatly dependent on the site occupancy of B′, B″ and B‴ cations.

5. We have reported the structural properties of $BaCo_{1/3}Nb_{2/3}O_3$ and $BaCo_{1/3}Sb_{2/3}O_3$ synthesized by solid state ceramic method along with their microstructural and FITR study. Their cationic disorder has been investigated using Raman spectroscopy. From the dielectric study of the samples, we have concluded that the constituent B-site cations in perovskite oxides plays a crucial role in determining their polarizability and hence their dielectric properties.

The thesis is based on the following publications:

(i) Physica B 583 (2020) 412057

(ii) Physica B 649 (2023) 414449

(iii) AIP Conference Proceedings 1942 (2018) 110033

(iv) Journal of Alloys and Compounds 854 (2021) 157217

(v) Ionics 23 (2017) 471–483

Arpita Barua
(Signature of the candidate)
24.03.23

Sanjay Kumar
24.03.2023
(Signature of the supervisor)

Dr. SANJAY KUMAR
Professor
Department of Physics
Jadavpur University
Kolkata - 700032, India